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IS 6548 (1992): Rolling bearings - Instrument precision bearings [PGD 13: Bearing]

"ज्ञान से एक नये भारत का निर्माण"
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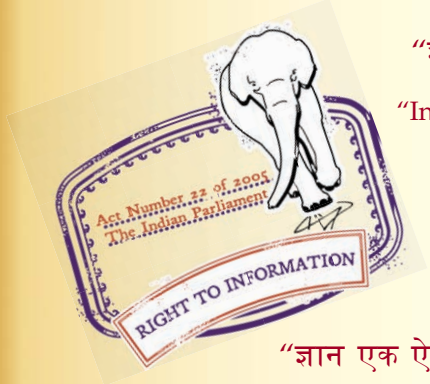

"ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है"
Bhartṛhari—Nītiśatakam
"Knowledge is such a treasure which cannot be stolen"

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IS 6548 : 1992
ISO 1224 : 1984
(Reaffirmed 1999)

भारतीय मानक

उपकरण परिशुद्धि वाले बेलनी बेयरिंगों का आयाम

(पहला पुनरीक्षण)

Indian Standard

ROLLING BEARINGS — INSTRUMENT PRECISION BEARINGS

(First Revision)

UDC 621·822·6

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

June 1992

Price Group 7

Indian Standard

ROLLING BEARINGS — INSTRUMENT PRECISION BEARINGS

(First Revision)

NATIONAL FOREWORD

This Indian Standard, which is identical with ISO 1224 : 1984 'Rolling bearings — Instrument precision bearings', issued by the International Organization for Standardization (ISO), was adopted by the Bureau of Indian Standards on the recommendations of the Rolling Bearings Sectional Committee (LM 12) and approval of the Light Mechanical Engineering Division Council.

The standard was originally published in 1972 and was based on ISO/R 1224 : 1971 'Rolling bearings — Instrument precision bearings', issued by ISO. The revision has been made by the adoption of the revised ISO 1224 : 1984. In this revision symbols for different dimensions and tolerances have been standardized.

The text of ISO standard has been approved as suitable for publication as Indian Standard without deviations. Certain conventions are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

a) Wherever the words 'International Standard' appear referring to this standard, they should be read as 'Indian Standard'.

b) Comma (,) has been used as a decimal marker in ISO Standard while in Indian Standard, the current practice is to use full stop (.) as the decimal marker.

In this adopted standard, reference appears to certain International Standards for which Indian Standards also exist. The corresponding Indian Standards which are to be substituted in their place are listed below alongwith their degree of equivalence for the editions indicated:

International Standard	*Corresponding Indian Standard*	*Degree of Equivalence*
ISO 15	IS 5669 : 1987 General plan of boundary dimensions for radial rolling bearings (*first revision*)	identical
ISO 582	IS 5934 : 1987 Chamfer dimensions limits for rolling bearings (*first revision*)	Identical
ISO 5593	IS 2399 : 1988 Rolling bearings — Vocabulary (*first revision*)	Identical

NOTE — Dimensions given in the inch series are not to be considered as part of the standard.

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1 Scope and field of application

This International Standard specifies the characteristics that define instrument precision rolling bearings, their types, boundary dimensions, tolerances and internal clearance, classifications used for selective assembly, torque definitions and test conditions, and limitations of bearing yield rates.

2 References

ISO 15, *Rolling bearings — Radial bearings — Boundary dimensions — General plan.*

ISO 582, *Rolling bearings — Metric series — Chamfer dimension limits.*

ISO 5593, *Rolling bearings — Vocabulary.*

3 Definitions and symbols

For the purpose of this International Standard, the definitions of ISO 5593, and the following, apply.

3.1 variation of bore generatrix inclination with face, S_{d1} (inner ring, reference face): Total variation of the relative position, in a radial direction parallel with the plane tangential to the reference face of the inner ring, of points on the same generatrix of the bore at a distance from the side faces of the ring equal to the largest permissible axial single chamfer dimension.

3.2 assembled bearing outer ring flange back face runout with raceway, S_{ea1} (groove ball bearing): Difference between the largest and the smallest of the axial distances between the outer ring flange back face, in different relative angular positions of this ring, at a radial distance from the outer ring axis equal to half the flange back face mean diameter, and a point in a fixed position relative to the inner ring. The inner and outer ring raceways shall be in contact with all the balls.

3.3 torque quality: The torque quality of an instrument ball bearing is a function of average and maximum torques. Maximum torque is most frequently specified for slow speed (near zero) applications and for limited arcs of travel. Where considerable rotation is involved, average torque may be the criterion.

3.4 maximum torque: The maximum value of torque recorded during any test cycle.

3.5 average torque: The arithmetic mean value of the torque readings obtained during the test cycle.

3.6 test load: A specified axial load coincident with the axis of rotation of the bearing.

A list of symbols is given in table 1.

Table 1 — Symbols

Symbol	Term (see ISO 5593 for definition)
d	nominal bore diameter
Δ_{ds}	deviation of a single bore diameter
Δ_{dmp}	single plane mean bore diameter deviation
V_{dp}	bore diameter variation in a single radial plane
V_{dmp}	mean bore diameter variation
D	nominal outside diameter of the bearing
Δ_{Ds}	deviation of a single outside diameter of the bearing
Δ_{Dmp}	single plane mean outside diameter deviation of the bearing
V_{Dp}	outside diameter variation in a single radial plane of the bearing
V_{Dmp}	mean outside diameter variation of the bearing
D_1	nominal outside diameter of the outer ring flange
Δ_{D1s}	deviation of a single outside diameter of the outer ring flange
B	nominal inner ring width
Δ_{Bs}	deviation of a single inner ring width
V_{Bs}	inner ring width variation
C	nominal outer ring width
Δ_{Cs}	deviation of a single outer ring width
V_{Cs}	outer ring width variation
C_1	nominal outer ring flange width
Δ_{C1s}	deviation of a single outer ring flange width
V_{C1s}	outer ring flange width variation
r	chamfer dimension (except where r_1 is applicable)
r_{smin}	smallest permissible single chamfer dimension (r)
r_{smax}	largest permissible single chamfer dimension (r)
r_1	chamfer dimension of the front face of angular contact ball bearing inner and outer rings
r_{1smin}	smallest permissible single chamfer dimension (r_1)
r_{1smax}	largest permissible single chamfer dimension (r_1)
K_{ia}	radial runout of assembled bearing inner ring
K_{ea}	radial runout of assembled bearing outer ring
S_d	face runout with bore[1]
S_{d1}	variation of bore generatrix inclination with face[1), 2)]
S_D	variation of outside surface generatrix inclination with face[1)]
S_{ia}	assembled bearing inner ring face runout with raceway[1)]
S_{ea}	assembled bearing outer ring face runout with raceway[1)]
S_{ea1}	assembled bearing outer ring flange back face runout with raceway[3)]

1) For angular contact ball bearings, the back face of a ring is the reference face.

2) See 3.1.

3) See 3.2.

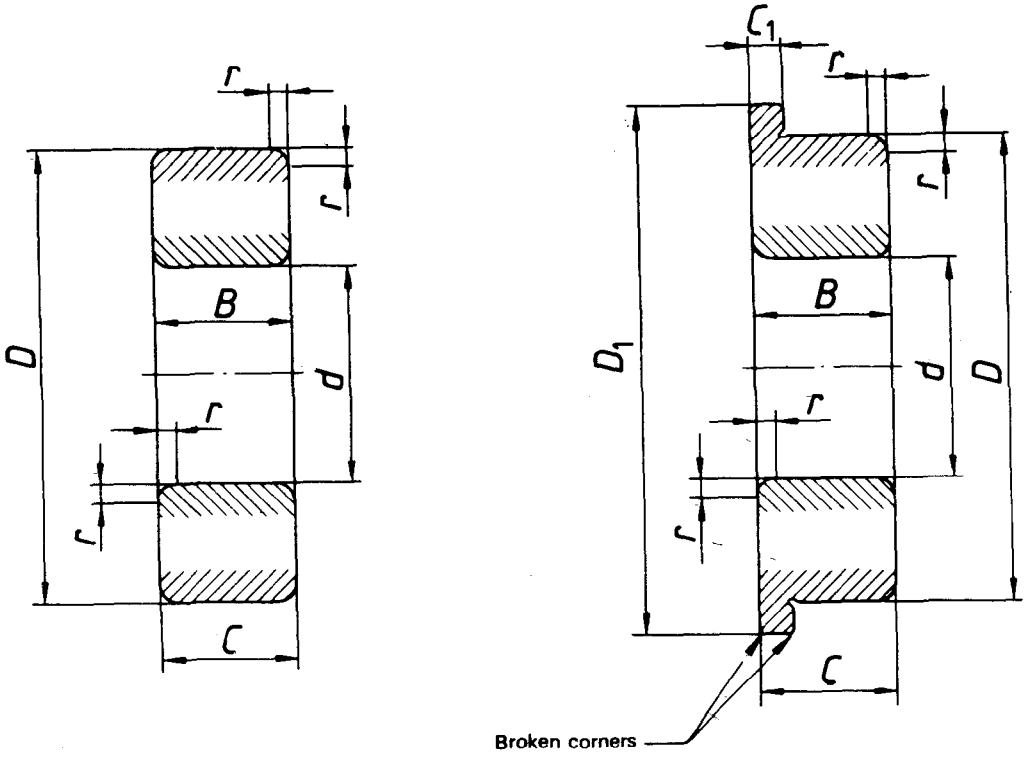

Figure — Boundary dimension symbols

4 Characteristics

Satisfactory performance of instrument precision bearings necessitates that they be produced to special tolerances, as given in clause 7. In addition, these bearings shall be particularly free from foreign matter and meet one or more specific requirements in the following categories:

a) low torque or uniform torque or both, either at starting or in rotation (this requirement does not apply to bearings with seals);

b) smooth running or vibration limitations;

c) limitations of bearing yield rates.

Due to the many specialized requirements that exist in instrument applications, specification of these categories should be established only after full agreement between manufacturer and user.

5 Bearing types

Single row deep groove ball bearings meet the majority of requirements and may be flanged or unflanged, open or capped. However, for specific applications, angular contact ball bearings, non-separable or with separable inner ring, may be required.

6 Boundary dimensions

Table 2 — Metric series bearings

Dimensions in millimetres

d	D	B and C	r_{smin}	r_{1smin}	Flanged bearings		Applicable types of bearing	Dimension series[1)]
					D_1	C_1		
0,6	2	0,8	0,05	0,05	—	—	open	17
1	2,5	1	0,05	0,05	—	—	open	17
1	3	1	0,05	0,05	3,8	0,3	open	18
1	3	1,5	0,05	0,05	3,8	0,45	capped	38
1	4	1,6	0,1	0,05	5	0,5	open	19
1	4	2,3	0,1	0,05	5	0,6	capped	39
1,5	3	1	0,05	0,05	—	—	open	17
1,5	4	1,2	0,05	0,05	5	0,4	open	18
1,5	4	2	0,05	0,05	5	0,6	capped	38
1,5	5	2	0,15	0,08	6,5	0,6	open	19
1,5	5	2,6	0,15	0,08	6,5	0,8	capped	39
2	4	1,2	0,05	0,05	—	—	open	17
2	5	1,5	0,08	0,05	6,1	0,5	open	18
2	5	2,3	0,08	0,05	6,1	0,6	capped	38
2	6	2,3	0,15	0,08	7,5	0,6	open, capped	19
2	6	3	0,15	0,08	7,5	0,8	capped	39
2,5	5	1,5	0,08	0,05	—	—	open	17
2,5	6	1,8	0,08	0,05	7,1	0,5	open	18
2,5	6	2,6	0,08	0,05	7,1	0,8	capped	38
2,5	7	2,5	0,15	0,08	8,5	0,7	open, capped	19
2,5	7	3,5	0,15	0,08	8,5	0,9	capped	39
3	6	2	0,08	0,05	—	—	open	17
3	7	2	0,1	0,05	8,1	0,5	open	18
3	7	3	0,1	0,05	8,1	0,8	capped	38
3	8	3	0,15	0,08	9,5	0,7	open, capped	19
3	8	4	0,15	0,08	9,5	0,9	capped	39
3	10	4	0,15	0,08	11,5	1	open, capped	02
4	7	2	0,08	0,05	—	—	open	17
4	9	2,5	0,1	0,05	10,3	0,6	open	18
4	9	4	0,1	0,05	10,3	1	capped	38
4	11	4	0,15	0,08	12,5	1	open, capped	19
4	13	5	0,2	0,1	15	1	open, capped	02
4	16	5	0,3	0,15	—	—	open, capped	03
5	8	2	0,08	0,05	—	—	open	17
5	11	3	0,15	0,08	12,5	0,8	open	18
5	11	5	0,15	0,08	12,5	1	capped	38
5	13	4	0,2	0,1	15	1	open, capped	19
5	16	5	0,3	0,15	18	1	open, capped	02
5	19	6	0,3	0,15	22	1,5	open, capped	03

Table 2 — Metric series bearings (*concluded*)

Dimensions in millimetres

d	D	B and C	r_{smin}	r_{1smin}	Flanged bearings		Applicable types of bearing	Dimension series[1]
					D_1	C_1		
6	10	2,5	0,1	0,05	—	—	open	17
6	13	3,5	0,15	0,08	15	1	open	18
6	13	5	0,15	0,08	15	1,1	capped	28
6	15	5	0,2	0,1	17	1,2	open, capped	19
6	19	6	0,3	0,15	22	1,5	open, capped	02
7	11	2,5	0,1	0,05	—	—	open	17
7	14	3,5	0,15	0,08	16	1	open	18
7	14	5	0,15	0,08	16	1,1	capped	28
7	17	5	0,3	0,15	19	1,2	open, capped	19
7	19	6	0,3	0,15	22	1,5	open, capped	10
7	22	7	0,3	0,15	—	—	open, capped	02
8	12	2,5	0,1	0,05	—	—	open	17
8	16	4	0,2	0,1	18	1	open	18
8	16	6	0,2	0,1	18	1,3	capped	38
8	19	6	0,3	0,15	22	1,5	open, capped	19
8	22	7	0,3	0,15	—	—	open, capped	10
8	24	8	0,3	0,15	—	—	open	02
9	14	3	0,1	0,05	—	—	open	17
9	17	4	0,2	0,1	19	1	open	18
9	17	6	0,2	0,1	19	1,3	capped	38
9	20	6	0,3	0,15	—	—	open, capped	19
9	24	7	0,3	0,15	—	—	open, capped	10
9	26	8	0,3	0,15	—	—	open, capped	02
10	15	3	0,1	0,05	—	—	open	17
10	19	5	0,3	0,15	21	1	open	18
10	19	7	0,3	0,15	21	1,5	capped	38
10	22	6	0,3	0,15	—	—	open, capped	19
10	26	8	0,3	0,15	—	—	open, capped	10
10	30	9	0,6	0,3	—	—	open, capped	02

1) Dimension series quoted are those given in ISO 15 for unflanged bearings.

Table 3 — Inch series bearings — Dimensions in millimetres

d	D	B and C	r_{smin}	r_{1smin}	Flanged bearings		Applicable types of bearing
					D_1	C_1	
0,635	2,540	0,792	0,08	0,08	—	—	open
1,016	3,175	1,191	0,08	0,08	—	—	open
1,191	3,967	1,588	0,08	0,08	5,16	0,33	open
1,191	3,967	2,380	0,08	0,08	5,16	0,79	capped
1,397	4,762	1,984	0,08	0,08	5,94	0,58	open
1,397	4,762	2,779	0,08	0,08	5,94	0,79	capped
1,984	6,350	2,380	0,08	0,08	7,52	0,58	open
1,984	6,350	3,571	0,08	0,08	7,52	0,79	capped
2,380	4,762	1,588	0,08	0,08	5,94	0,46	open
2,380	4,762	2,380	0,08	0,08	5,94	0,79	capped
2,380	7,938	2,779	0,13	0,08	9,12	0,58	open
2,380	7,938	3,571	0,13	0,08	9,12	0,79	capped
3,175	6,350	2,380	0,08	0,08	7,52	0,58	open
3,175	6,350	2,779	0,08	0,08	7,52	0,79	capped
3,175	7,938	2,779	0,08	0,08	9,12	0,58	open
3,175	7,938	3,571	0,08	0,08	9,12	0,79	capped
3,175	9,525	2,779	0,13	0,08	10,72	0,58	open
3,175	9,525	3,571	0,13	0,08	10,72	0,79	capped
3,175	9,525	3,967	0,30	0,15	11,18	0,76	open, capped
3,175	12,700	4,366	0,30	0,15	—	—	open, capped
3,967	7,938	2,779	0,08	0,08	9,12	0,58	open
3,967	7,938	3,175	0,08	0,08	9,12	0,91	capped
4,762	7,938	2,779	0,08	0,08	9,12	0,58	open
4,762	7,938	3,175	0,08	0,08	9,12	0,91	capped
4,762	9,525	3,175	0,08	0,08	10,72	0,58	open
4,762	9,525	3,175	0,08	0,08	10,72	0,79	capped
4,762	12,700	3,967	0,30	0,15	—	—	open
4,762	12,700	4,978	0,30	0,15	14,35	1,07	open[1], capped
5,555	7,938	2,779	0,08	0,08	—	—	open
6,350	9,525	3,175	0,08	0,08	10,72	0,58	open
6,350	9,525	3,175	0,08	0,08	10,72	0,91	capped
6,350	12,700	3,175	0,13	0,08	13,89	0,58	open
6,350	12,700	4,762	0,13	0,08	13,89	1,14	capped
6,350	15,875	4,978	0,30	0,15	17,53	1,07	open, capped
6,350	19,050	5,558	0,41	0,20	—	—	open
6,350	19,050	7,142	0,41	0,20	—	—	capped
7,938	12,700	3,967	0,13	0,08	13,89	0,79	open, capped
9,525	15,875	3,967	0,25	0,13	17,53	1,07	open
9,525	15,875	4,978	0,25	0,13	17,53	1,07	capped
9,525	22,225	5,558	0,41	0,20	—	—	open
9,525	22,225	7,142	0,41	0,20	24,61	1,57	open[1], capped

1) Open bearing with flange only.

Table 4 — Inch series bearings — Dimensions in inches

d	D	B and C	r_{smin}	r_{1smin}	Flanged bearings		Applicable types of bearing
					D_1	C_1	
0.025 0	0.100 0	0.031 2	0.003	0.003	—	—	open
0.040 0	0.125 0	0.046 9	0.003	0.003	—	—	open
0.046 9	0.156 2	0.062 5	0.003	0.003	0.203	0.013	open
0.046 9	0.156 2	0.093 7	0.003	0.003	0.203	0.031	capped
0.055 0	0.187 5	0.078 1	0.003	0.003	0.234	0.023	open
0.055 0	0.187 5	0.109 4	0.003	0.003	0.234	0.031	capped
0.078 1	0.250 0	0.093 7	0.003	0.003	0.296	0.023	open
0.078 1	0.250 0	0.140 6	0.003	0.003	0.296	0.031	capped
0.093 7	0.187 5	0.062 5	0.003	0.003	0.234	0.018	open
0.093 7	0.187 5	0.093 7	0.003	0.003	0.234	0.031	capped
0.093 7	0.312 5	0.109 4	0.005	0.003	0.359	0.023	open
0.093 7	0.312 5	0.140 6	0.005	0.003	0.359	0.031	capped
0.125 0	0.250 0	0.093 7	0.003	0.003	0.296	0.023	open
0.125 0	0.250 0	0.109 4	0.003	0.003	0.296	0.031	capped
0.125 0	0.312 5	0.109 4	0.003	0.003	0.359	0.023	open
0.125 0	0.312 5	0.140 6	0.003	0.003	0.359	0.031	capped
0.125 0	0.375 0	0.109 4	0.005	0.003	0.422	0.023	open
0.125 0	0.375 0	0.140 6	0.005	0.003	0.422	0.031	capped
0.125 0	0.375 0	0.156 2	0.012	0.006	0.440	0.030	open, capped
0.125 0	0.500 0	0.171 9	0.012	0.006	—	—	open, capped
0.156 2	0.312 5	0.109 4	0.003	0.003	0.359	0.023	open
0.156 2	0.312 5	0.125 0	0.003	0.003	0.359	0.036	capped
0.187 5	0.312 5	0.109 4	0.003	0.003	0.359	0.023	open
0.187 5	0.312 5	0.125 0	0.003	0.003	0.359	0.036	capped
0.187 5	0.375 0	0.125 0	0.003	0.003	0.422	0.023	open
0.187 5	0.375 0	0.125 0	0.003	0.003	0.422	0.031	capped
0.187 5	0.500 0	0.156 2	0.012	0.006	—	—	open
0.187 5	0.500 0	0.196 0	0.012	0.006	0.565	0.042	open[1], capped
0.218 7	0.312 5	0.109 4	0.003	0.003	—	—	open
0.250 0	0.375 0	0.125 0	0.003	0.003	0.422	0.023	open
0.250 0	0.375 0	0.125 0	0.003	0.003	0.422	0.036	capped
0.250 0	0.500 0	0.125 0	0.005	0.003	0.547	0.023	open
0.250 0	0.500 0	0.187 5	0.005	0.003	0.547	0.045	capped
0.250 0	0.625 0	0.196 0	0.012	0.006	0.690	0.042	open, capped
0.250 0	0.750 0	0.218 8	0.016	0.008	—	—	open
0.250 0	0.750 0	0.281 2	0.016	0.008	—	—	capped
0.312 5	0.500 0	0.156 2	0.005	0.003	0.547	0.031	open, capped
0.375 0	0.625 0	0.156 2	0.010	0.005	0.690	0.042	open
0.375 0	0.625 0	0.196 0	0.010	0.005	0.690	0.042	capped
0.375 0	0.875 0	0.218 8	0.016	0.008	—	—	open
0.375 0	0.875 0	0.281 2	0.016	0.008	0.969	0.062	open[1], capped

1) Open bearing with flange only.

7 Tolerances

7.1 Tolerance class 5A

Table 5 — Inner ring

d		Δ_{dmp}		Δ_{ds}		V_{dp}	V_{dmp}	Δ_{Bs}[2]		V_{Bs}	K_{ia}	S_{d1}[3]	S_{ia}
over	incl.	high	low	high	low	max.	max.	high	low	max.	max.	max.	max.
mm		μm											
0,6[1]	10	0	−5	0	−5	3	3	0	−25	5	3,5	7	7
inches		0.000 1 inch											
0.024[1]	0.394	0	−2	0	−2	1.2	1.2	0	−10	2	1.5	3	3

1) This diameter is included in the group.

2) The tolerance for the total width of the inner rings of a matched pair or a matched stack is 0 to −200 μm (−0.007 9 inches) times the number of bearings in the mounting.

3) Largest permissible inner ring reference face runout with bore (S_{dmax}) is

$$S_{dmax} = S_{d1max} \frac{F}{2(B - 2r_{smax})}$$

where S_{d1max} is obtained from table 5 and F is the inner ring raceway contact diameter.

Table 6 — Outer ring

D		Δ_{Dmp}		Δ_{Ds}				V_{Dp} and V_{Dmp}		Δ_{Cs}[2]		V_{Cs}	K_{ea}	S_D	S_{ea}	S_{ea1}	Δ_{C1s}		V_{C1s}	Δ_{D1s}	
				open		capped		open	capped												
over	incl.	high	low	high	low	high	low	max.	max.	high	low	max.	max.	max.	max.	max.	high	low	max.	high	low
mm		μm																			
2[1]	18	0	−5	0	−5	+1	−6	3	5	0	−25	5	5	8	8	10	0	−50	5	0	−25
18	30	0	−6	0	−6	+1	−7	3	5	0	−25	5	6	8	8	10	0	−50	5	0	−25
inches		0.000 1 inch																			
0.079[1]	0.709	0	−2	0	−2	+0.4	−2.4	1.2	2	0	−10	2	2	3.1	3.1	4	0	−20	2	0	−10
0.709	1.181	0	−2.4	0	−2.4	+0.4	−3	1.2	2	0	−10	2	2.4	3.1	3.1	4	0	−20	2	0	−10

1) This diameter is included in the group.

2) The tolerance for the total width of the outer rings of a matched pair or a matched stack is 0 to −200 μm (−0.007 9 inches) times the number of bearings in the mounting.

7.2 Tolerance class 4A

Table 7 — Inner ring

d		Δ_{dmp}		Δ_{ds}		V_{dp}	V_{dmp}	Δ_{Bs} [2]		V_{Bs}	K_{ia}	S_{d1} [3]	S_{ia}
over	incl.	high	low	high	low	max.	max.	high	low	max.	max.	max.	max.
mm		μm											
0.6[1]	10	0	−5	0	−5	2,5	2,5	0	−25	2,5	2,5	3	3
inches		0.000 1 inch											
0.024[1]	0.394	0	−2	0	−2	1	1	0	−10	1	1	1.2	1.2

1) This diameter is included in the group.

2) The tolerance for the total width of the inner rings of a matched pair or a matched stack is 0 to − 200 μm (− 0.007 9 inches) times the number of bearings in the mounting.

3) Largest permissible inner ring reference face runout with bore (S_{dmax}) is

$$S_{dmax} = S_{d1max} \frac{F}{2(B - 2r_{smax})}$$

where S_{d1max} is obtained from table 7 and F is the inner ring raceway contact diameter.

Table 8 — Outer ring

D		Δ_{Dmp}		Δ_{Ds}				V_{Dp} and V_{Dmp}		Δ_{Cs} [2]		V_{Cs}	K_{ea}	S_D	S_{ea}	S_{ea1}	Δ_{C1s}		V_{C1s}	Δ_{D1s}	
				open		capped		open	capped												
over	incl.	high	low	high	low	high	low	max.	max.	high	low	max.	max.	max.	max.	max.	high	low	max.	high	low
mm		μm																			
2[1]	18	0	−5	0	−5	+1	−6	2,5	5	0	−25	2,5	3,5	4	5	8	0	−50	2,5	0	−25
18	30	0	−5	0	−5	+1	−6	2,5	5	0	−25	2,5	4	4	5	8	0	−50	2,5	0	−25
inches		0.000 1 inch																			
0.079[1]	0.709	0	−2	0	−2	+0.4	−2.4	1	2	0	−10	1	1.4	1.6	2	3.1	0	−20	1	0	−10
0.709	1.181	0	−2	0	−2	+0.4	−2.4	1	2	0	−10	1	1.6	1.6	2	3.1	0	−20	1	0	−10

1) This diameter is included in the group.

2) The tolerance for the total width of the outer rings of a matched pair or a matched stack is 0 to − 200 μm (− 0.007 9 inches) times the number of bearings in the mounting.

7.3 Chamfer dimension limits

Smallest permissible single chamfer dimensions (r_{smin} and r_{1smin}) are given in tables 2, 3 and 4.

For metric series bearings, largest permissible single chamfer dimensions (r_{smax} and r_{1smax}) are given in ISO 582.

For inch series bearings, largest permissible single chamfer dimensions (r_{smax} and r_{1smax}) are given in tables 9 and 10.

Table 9 — Inch series bearings — Dimensions in millimetres

d	D	B and C	r_{smax}		r_{1smax}	
			radial direction	axial direction	radial direction	axial direction
0,635	2,540	0,792	0,18	0,18	0,18	0,18
1,016	3,175	1,191	0,18	0,18	0,18	0,18
1,191	3,967	1,588	0,23	0,23	0,18	0,18
1,191	3,967	2,380	0,23	0,30	0,23	0,30
1,397	4,762	1,984	0,23	0,23	0,23	0,23
1,397	4,762	2,779	0,23	0,30	0,23	0,30
1,984	6,350	2,380	0,23	0,30	0,23	0,30
1,984	6,350	3,571	0,23	0,30	0,23	0,30
2,380	4,762	1,588	0,20	0,20	0,20	0,20
2,380	4,762	2,380	0,20	0,30	0,20	0,30
2,380	7,938	2,779	0,30	0,61	0,25	0,25
2,380	7,938	3,571	0,30	0,61	0,25	0,25
3,175	6,350	2,380	0,23	0,30	0,23	0,30
3,175	6,350	2,779	0,23	0,30	0,23	0,30
3,175	7,938	2,779	0,25	0,46	0,25	0,46
3,175	7,938	3,571	0,25	0,46	0,25	0,46
3,175	9,525	2,779	0,30	0,61	0,25	0,25
3,175	9,525	3,571	0,30	0,61	0,25	0,25
3,175	9,525	3,967	0,56	0,99	0,30	0,30
3,175	12,700	4,366	0,56	0,99	0,30	0,30
3,967	7,938	2,779	0,23	0,30	0,23	0,30
3,967	7,938	3,175	0,23	0,30	0,23	0,30
4,762	7,938	2,779	0,23	0,30	0,23	0,30
4,762	7,938	3,175	0,23	0,30	0,23	0,30
4,762	9,525	3,175	0,25	0,46	0,25	0,46
4,762	9,525	3,175	0,25	0,46	0,25	0,46
4,762	12,700	3,967	0,56	0,99	0,30	0,30
4,762	12,700	4,978	0,56	0,99	0,30	0,30
5,555	7,938	2,779	0,23	0,30	0,23	0,30
6,350	9,525	3,175	0,20	0,30	0,20	0,30
6,350	9,525	3,175	0,20	0,30	0,20	0,30
6,350	12,700	3,175	0,30	0,61	0,25	0,25
6,350	12,700	4,762	0,30	0,61	0,25	0,25
6,350	15,875	4,978	0,56	0,99	0,30	0,30
6,350	19,050	5,558	0,71	0,99	0,51	0,51
6,350	19,050	7,142	0,71	0,99	0,51	0,51
7,938	12,700	3,967	0,30	0,61	0,25	0,25
9,525	15,875	3,967	0,51	0,79	0,30	0,30
9,525	15,875	4,978	0,51	0,79	0,30	0,30
9,525	22,225	5,558	0,71	0,99	0,51	0,51
9,525	22,225	7,142	0,71	0,99	0,51	0,51

Table 10 — Inch series bearings — Dimensions in inches

d	D	B and C	r_{smax}		r_{1smax}	
			radial direction	axial direction	radial direction	axial direction
0.025 0	0.100 0	0.031 2	0.007	0.007	0.007	0.007
0.040 0	0.125 0	0.046 9	0.007	0.007	0.007	0.007
0.046 9	0.156 2	0.062 5	0.009	0.009	0.007	0.007
0.046 9	0.156 2	0.093 7	0.009	0.012	0.009	0.012
0.055 0	0.187 5	0.078 1	0.009	0.009	0.009	0.009
0.055 0	0.187 5	0.109 4	0.009	0.012	0.009	0.012
0.078 1	0.250 0	0.093 7	0.009	0.012	0.009	0.012
0.078 1	0.250 0	0.140 6	0.009	0.012	0.009	0.012
0.093 7	0.187 5	0.062 5	0.008	0.008	0.008	0.008
0.093 7	0.187 5	0.093 7	0.008	0.012	0.008	0.012
0.093 7	0.312 5	0.109 4	0.012	0.024	0.010	0.010
0.093 7	0.312 5	0.140 6	0.012	0.024	0.010	0.010
0.125 0	0.250 0	0.093 7	0.009	0.012	0.009	0.012
0.125 0	0.250 0	0.109 4	0.009	0.012	0.009	0.012
0.125 0	0.312 5	0.109 4	0.010	0.018	0.010	0.018
0.125 0	0.312 5	0.140 6	0.010	0.018	0.010	0.018
0.125 0	0.375 0	0.109 4	0.012	0.024	0.010	0.010
0.125 0	0.375 0	0.140 6	0.012	0.024	0.010	0.010
0.125 0	0.375 0	0.156 2	0.022	0.039	0.012	0.012
0.125 0	0.500 0	0.171 9	0.022	0.039	0.012	0.012
0.156 2	0.312 5	0.109 4	0.009	0.012	0.009	0.012
0.156 2	0.312 5	0.125 0	0.009	0.012	0.009	0.012
0.187 5	0.312 5	0.109 4	0.009	0.012	0.009	0.012
0.187 5	0.312 5	0.125 0	0.009	0.012	0.009	0.012
0.187 5	0.375 0	0.125 0	0.010	0.018	0.010	0.018
0.187 5	0.375 0	0.125 0	0.010	0.018	0.010	0.018
0.187 5	0.500 0	0.156 2	0.022	0.039	0.012	0.012
0.187 5	0.500 0	0.196 0	0.022	0.039	0.012	0.012
0.218 7	0.312 5	0.109 4	0.009	0.012	0.009	0.012
0.250 0	0.375 0	0.125 0	0.008	0.012	0.008	0.012
0.250 0	0.375 0	0.125 0	0.008	0.012	0.008	0.012
0.250 0	0.500 0	0.125 0	0.012	0.024	0.010	0.010
0.250 0	0.500 0	0.187 5	0.012	0.024	0.010	0.010
0.250 0	0.625 0	0.196 0	0.022	0.039	0.012	0.012
0.250 0	0.750 0	0.218 8	0.028	0.039	0.020	0.020
0.250 0	0.750 0	0.281 2	0.028	0.039	0.020	0.020
0.312 5	0.500 0	0.156 2	0.012	0.024	0.010	0.010
0.375 0	0.625 0	0.156 2	0.020	0.031	0.012	0.012
0.375 0	0.625 0	0.196 0	0.020	0.031	0.012	0.012
0.375 0	0.875 0	0.218 8	0.028	0.039	0.020	0.020
0.375 0	0.875 0	0.281 2	0.028	0.039	0.020	0.020

8 Radial internal clearance

Table 11 — Radial internal clearance of single row radial contact groove ball bearings

d		Group 2		Normal group		Group 3	
over	incl.	min.	max.	min.	max.	min.	max.
mm		μm					
0,6[1]	10	0	6	4	11	10	20
inches		0.000 1 inch					
0.024[1]	0.394	0	2.5	1.5	4.5	4	8

1) This diameter is included.

9 Bore and outside diameter classification

When required for selective assembly to shafts and housings, instrument precision rolling bearings may be classified into specific size groupings in accordance with the following provisions.

a) Method of size determination:

1) outside diameter: the largest diameter measured;

2) bore diameter: the smallest diameter measured.

b) Two equal range groups for each basic diameter, unless otherwise agreed.

c) Due to difficulties in gauge correlation between manufacturer and user, the classifications shall be considered only as guides for selective assembly and not as absolute size segregations in borderline cases.

d) It is understood that, unless special arrangement is made with the manufacturer, random and not specific quantities of size groupings will be supplied.

10 Torque test conditions

10.1 General

Torque of ball bearings may be specified as "running torque" or "starting torque" as defined in 06.01 in ISO 5593.

The standard unit of torque is the micronewton metre. Convenient multiples thereof may also be used.

The axis position of the bearing should be vertical unless otherwise specified.

10.2 *Test conditions*

10.2.1 Ambient conditions

Testing should be carried out in a controlled atmosphere, in clean surroundings and on a vibration-free base. Temperature range should be from 20 to 25 °C and relative humidity should be maintained below 55 %.

10.2.2 Pre-test condition of bearings

Before testing, bearings should be demagnetized and cleaned thoroughly with suitably filtered, clean mineral solvent. Bearings should be lubricated with the specified quantity and quality of lubricant. Bearings should be rotated slowly to distribute the lubricant.

10.2.3 Test load

The axial test load (see 3.6) should be as follows:

a) for bearings having an outside diameter less than or equal to 8 mm (0.312 5 in): 0,75 N;

b) for bearings having an outside diameter over 8 mm (0.312 5 in): 1,5 N or 4 N as agreed.

10.2.4 Extent of testing

Tests should be conducted in such a manner as to ensure compliance within specified torque limits in both directions of rotation and in both directions of loading on single row, non-filling slot ball bearings. For angular contact ball bearings and others that support axial loading in one direction only, torque specifications should apply only under the normal direction of loading.

10.2.4.1 Running torque

The test should be conducted with at least 720° of rotation of the specified rotating raceway member of the bearing.

10.2.4.2 Starting torque

The test should be conducted with a specified minimum number of starts, each start to be defined with a specified minimum arc of travel.

10.2.4.3 Retest provisions

Bearings that fail to pass the specified test should be demagnetized, cleaned, lubricated, and retested. Bearings failing the

second test should again be demagnetized, cleaned, lubricated and retested. All bearings failing to pass the third test should be considered as failing the test.

10.3 Correlation of test results on different types of test equipment

Since no two rolling bearings are exactly identical as to average torque (see 3.5) and maximum torque (see 3.4) values and, furthermore, since different types of test equipment exhibit differing degrees of extent and exaggeration of peak torque values, correlation of measurement between different types of test equipment has proved difficult to resolve. Specification of torque values, therefore, should be agreed upon the basis of a particular type and design of test equipment, unless correlation of test results on different test equipment between supplier and user is well established and understood.

11 Limitations of bearing yield rates

Special requirements for accurate positional control of a rotating member in relation to its support may necessitate limitations of bearing yield rates. These yield rate limitations are governed by specialized control of bearing contact angles and/or preload.

Contact angle is established by the magnitude of bearing radial internal clearance, internal design and applied axial preload and largely governs the magnitudes of the axial and radial yield rates. When tolerances on contact angle are specified, normal radial internal clearance standards do not apply.

Axial preload is established by axially loading one bearing against another either by an adjustment system external to the bearings or by the use of axially preloaded matched pairs of bearings which, when the appropriate rings are clamped together, will establish the required magnitude of axial loading within the pair. In such cases, the normal tolerances that apply to the individual ring width may be exceeded.

Due to the many specialized requirements that exist in this field of application and since axial preloading and contact angle controls affect endurance life and restraining torques, specifications should be established only after full agreement between manufacturer and user.

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